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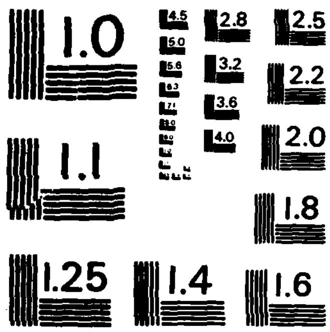
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DLA Materiel Readiness Support (MARS) System Interface with Service Readiness Models

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PREFACE

This report investigates the potential for interfacing the DLA Materiel Readiness Support (MARS) System with the "sparing-to-availability" models of the Military Services. Although DLA is the DoD wholesale manager of millions of consumable items, it lacks a means for determining how it impacts on the materiel readiness of the services. This shortfall could be filled by interfacing the MARS system with the models of the Services.

The report reviews the capabilities of the MARS system and then considers three popular Service models. It concludes that an aggregate analytic model approach could be used to relate consumable stock fund investment to weapon system availability by further development of the MARS system. A detailed line-item multi-echelon model approach is ruled out due to the lack of application data and the commonality of parts.

The report documents the findings of a feasibility study and, as such, does not represent the official position of the Agency on how DLA should proceed in assessing its impact on materiel readiness.

Acknowledgements

The DLA study team is indebted to the inventory analysts in the Office of the Secretary of Defense, Army, Navy, Air Force, Marine Corps, Center for Naval Analyses, Logistics Management Institute, and CACI, Inc., without whose gracious help this study could not have been completed.

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I. Introduction.

A. Background. The following definition for military capability was extracted from a 14 August 1981 Deputy Secretary of Defense memorandum to the Director, Joint Staff:

"Military Capability is the ability to achieve a specified wartime objective (e.g., win a war or battle, destroy a target set). It consists of four components:

1. Force Structure: the numbers, size, and composition of the units that comprise our Defense forces, e.g., divisions, ships, airwings.

2. Modernization: the technical sophistication of forces, units, weapon systems, and equipments.

3. Readiness: the ability of forces, units, weapon systems, or equipments to deliver the output for which they were designed (includes the ability to deploy and employ without unacceptable delays).

4. Sustainability: the "staying power" of our forces, units, weapon systems, and equipments, often measured in numbers of days."

The overall readiness of a unit to carry out a mission is dependent upon the operational readiness of the unit (training, morale, personnel availability, and personnel skills) and the materiel readiness of the unit (availability and reliability and maintainability of equipment) needed to perform the mission.

The logistics systems of the Military Services and the Defense Logistics Agency (DLA) support the availability of equipment at the unit level. The effects of Department of Defense (DoD) supply system policies on equipment availability have been studied extensively in recent years. The results of a representative sample of these studies are documented in section III, Service Readiness Models.

DLA is playing an increasingly important role in the supply support of weapon systems across the DoD. Presently, DLA stocks over 256,000 line items for over 450 weapon systems. In 1980, in an attempt to quantify the Agency's contribution to military readiness, the DLA Operations Research and Economic Analysis Office (DLA-LO) initiated the development of the DLA Materiel Readiness Support (MARS) System. The MARS system was intended to quantify DLA's level of supply support for a weapon system or military unit given DLA's present rules for managing and allocating resources. It was not originally intended to optimize stockage based on weapon system availability at the unit level. In 1984, MARS was at an advanced stage of development and DLA management decided to investigate the feasibility of interfacing MARS with Service readiness models to try to link DLA stockage investment to weapon system availability.

B. Purpose. The purpose of this study is to establish a basis for relating the MARS system to Service readiness models in order to better measure the DLA contribution to military readiness.

C. Objectives. The objectives of the study were twofold; specifically:

1. To identify and document Service readiness models which are presently used or planned to be used to measure the operational availability of weapon systems and/or other principal end items.

2. To investigate the potential for a MARS system interface with the identified Service readiness models.

D. Approach. Interviews were conducted with the Office of the Secretary of Defense (OSD), the Military Services, and other Defense-related organizations. The theme for these interviews was information exchange to provide mutual enhancement of analytic capability. Questions were directed towards the objectives listed above. Extensive research and follow-up was performed. The realization that DLA and the Services were working towards a common goal was pervasive. The findings, conclusions, and recommendations of our research are documented in this report.

E. Report Organization. In addition to these introductory sections, the report contains four additional sections and the appendices, as follows:

1. Section II presents a description of the DLA MARS system and how it is presently used.

2. Section III presents a description of various Service readiness models that relate inventory investment to operational availability.

3. Section IV provides a description of how MARS might be interfaced with a Service readiness model to relate DLA inventory investment to operational availability.

4. Section V presents the conclusions and recommendations of the study.

II. The DLA Materiel Readiness Support (MARS) System.

A. Introduction. The Materiel Readiness Support (MARS) System was developed to quantify and predict the level of supply support provided by DLA for a weapon system or to a Service organization, or a combination of both. MARS also quantifies the costs of providing a certain level of supply support to the weapon system or organization. The MARS system was not created to link the level of supply support of DLA-managed weapon system items to the availability of the weapon system at the user level. As such, MARS can be classified with a group of Service analytical models that will be called "Supply Performance Analyzers." These models are based on the DoD policy for Procurement Cycles and Safety Levels of Supply for Secondary Items as stated in DoDI 4140.39, dated 17 July 1970. These "Supply Performance Analyzer" models allow decision makers to estimate the effects of funding levels on supply performance. The objective of these models is to minimize total variable supply cost (inventory holding, procurement ordering, and implied time-weighted shortage) subject to a constraint on time-weighted requisitions short. This section provides a brief description of the MARS system.

B. System Description. The MARS system is comprised of three major components. These components of the MARS system allows the user to analyze DLA's materiel readiness support from the following perspectives:

1. Historical Support Analyses. The Historical Supply Performance Program (HISPER) of the MARS system produces statistics that reflect DLA's historical support to a weapon system and/or organizational unit. Using demand history on items used by the weapon system and/or organizational unit, the model identifies the supply performance for those items. Although demands for weapon system items may come from nonweapon system applications, the model uses all available indicators to try to isolate weapon system applications.

2. Projected Support Analyses. The Projected Supply Performance Model (PERMES) of the MARS system produces statistics that predict DLA's future support to selected item groupings under a variety of performance goals or budget allocations. After identifying what items are to be used, the model uses inventory control theory to compute future performance for those items. The computations involve current assets, expected requirements, and historical demand variance.

3. The Item Statistical Package. The Item Statistical Package (TISP) of the MARS system combines the capabilities of the Statistical Analysis System (SAS) software package with MARS-unique item data files to produce various types of statistics. Using TISP, these statistics can be displayed as a tabular or graphical presentation.

A MARS user may consider as readiness-related, any item deemed essential to a major weapon system or to a military unit directly related to the nation's readiness posture. As can be seen from the above descriptions, the system models are designed to analyze groups of items and measure support for the items in the group.

It must be kept in mind that when the models are used to measure support for a group of items identified to a weapon system, the military unit, or Service, items with multiple applications are analyzed with all of their requirements, not just the portion that applies to a particular weapon system. To some extent, a MARS user can narrow down the historical support to a weapon system by identifying the units where the system is based.

The reader should refer to the Materiel Readiness Decision Support System for a complete documentation of the MARS system including data base specifications. This document is available from the Headquarters, DLA Operations Research and Economic Analysis Office, Room 3B330, Cameron Station, Alexandria, VA 22314.

C. Use of MARS in the Budget Process. The projected supply performance model (PERMES) of the MARS system can be used to allocate safety level dollars to achieve DLA-managed weapon system item supply support objectives. The effectiveness of this budget allocation can be monitored using the historical supply performance program. Based on a comparison of the predicted vs. actual supply performance, the predictive algorithm can be adjusted to improve accuracy.

The managers of the Service Inventory Control Points and Central Design Activities all demonstrated considerable interest in the MARS system. The FY 1986-1990 Defense Guidance requires the Services and DLA to size peacetime inventories of secondary items based on weapon system availability objectives. It makes sense that both foreknowledge and history of DLA supply support to weapon system items will be useful in Service inventory control decision-making.

D. Summary. The DLA Materiel Readiness Support (MARS) system is an effective inventory analysis tool used to predict and monitor the level of DLA supply support to specific weapon system items or specific military units. In the ever-increasing role of DLA in weapon system management, MARS provides a valuable service in the evaluation of inventory policies for DLA-managed weapon system items. However, by itself, MARS, like the Army's Supply Performance Analyzer, the Navy's Computation and Research Evaluation System, and the Air Force Variable Safety Level Model, can not relate inventory levels of weapon system items to weapon system availability at the user level.

III. Service Readiness Models.

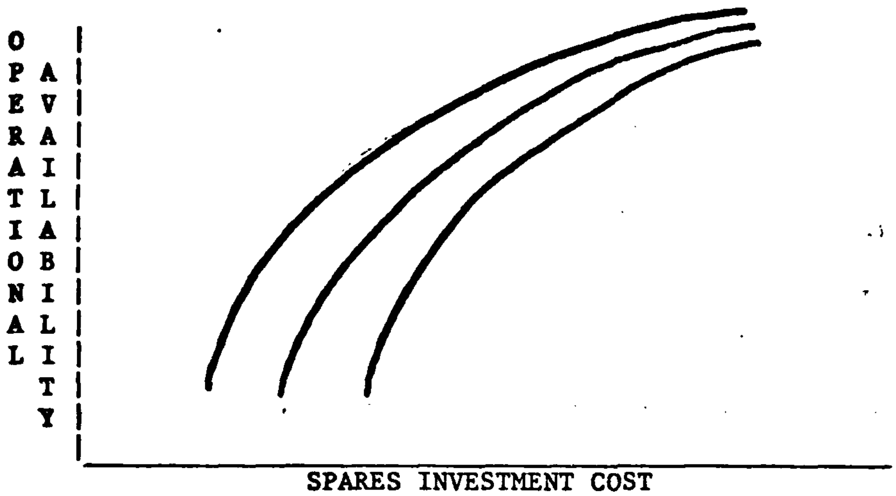
A. Introduction. The Department of Defense maintains inventories of spare and repair parts to support the readiness and sustainability of our military forces. The procurement of spares and repair parts meets several purposes: initial support for new weapon systems, replenishment support for peacetime operations, and additional spares for wartime levels of activity. These inventories are considered as having two main categories, peacetime operating stocks (POS) and war reserve materiel (WRM). Peacetime operating stocks directly support readiness while war reserve materiel is considered to most directly support sustainability. The measure used most frequently to determine the impact of POS on readiness is weapon system availability. Weapon system availability is defined as the probability that a weapon system is not inoperable waiting for a component to be repaired or shipped to it. The relationships between range and depth of spare and repair part inventories and end item materiel readiness is complex and, often, counterintuitive. Millions of dollars have been expended by DoD in recent years on the development of "sparing-to-availability" models. Although there has been valuable application of the theories of probability and stochastic processes to inventory control in this area, implementation of these models has been made with mixed results and there is a considerable amount of controversy among the Services concerning to what extent these models shall be used.

This section will give a brief description of three Service "Sparing-to-Availability" Models. The description will be in nontechnical language to the greatest extent possible. It should be understood that an in-depth discussion of each of these models could fill a large book. Accordingly, references for further reading are cited.

These "Sparing-to-Availability" models generate availability vs. cost curves, which represent the least cost mix of spares for a level of availability and conversely, the greatest achievable availability for a given level of investment.

Figure 1

Spares Investment Cost Curves



For each point on the curve, the model computes a set of line-item stock levels by quantity and location. The kind of availability models we will review require detailed line-item data. Attempts to use aggregate item data (e.g., average unit cost, failure rate, etc.) have failed to produce satisfactory results.

Figure 2 depicts a simplified representation of how materiel readiness is affected by the DoD inventory. When a failure occurs on the weapon system, the failure is isolated to a reparable component, which is then removed from the weapon system and replaced with a serviceable spare component from the lowest echelon of supply as soon as one is available. These items are known as first indentured items. The failed first indentured item enters the lowest echelon of maintenance, where it is repaired or designated as beyond the capability of maintenance for that echelon of maintenance. In such a case, the failed first indentured item is shipped to the next higher echelon of maintenance for repair, and a requisition is placed upon the next higher echelon of supply for a serviceable unit to be shipped to the user.

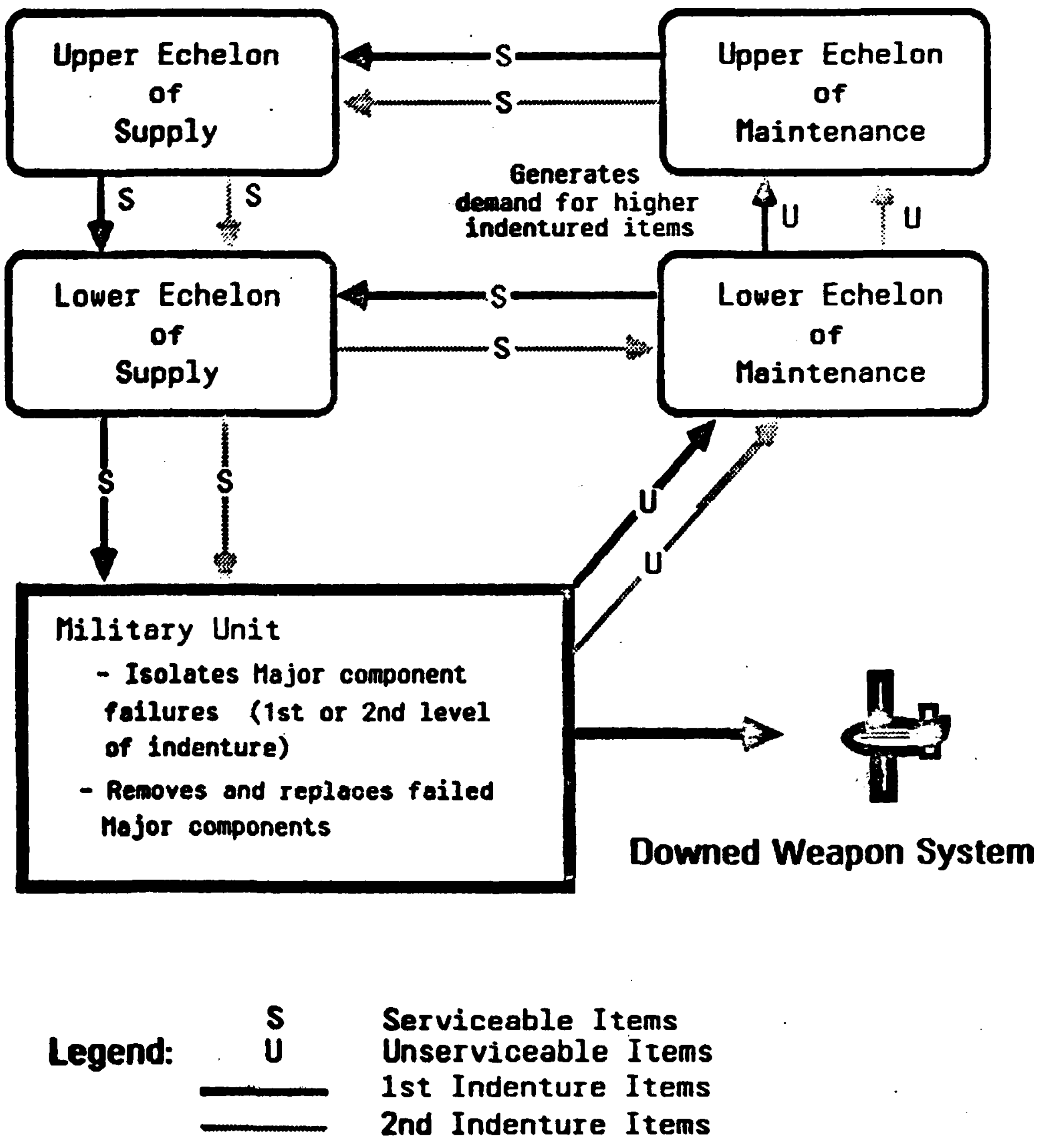
The lowest echelon of maintenance will, at most, isolate the problem to a failed subassembly, a second indentured level item, and remove that item. This failed item is removed and replaced at the user level with a serviceable spare from the lowest echelon of supply if one is available. The failed item is repaired at the lowest echelon of maintenance if possible (most likely by removal and replacement of a failed third indentured item) or sent to the next higher echelon of maintenance for repair.

Figure 2 shows that the effects of backorders for first and second indentured items are quite different. If there is no spare available for a failed first indentured item, the weapon system is not available for operations. Lack of a spare second indentured item delays the repair of first indentured items. If enough serviceable first indentured spares are available, there will be no direct effect on weapon system availability.

Figure 2

Weapon System Availability
in the DoD Inventory System

Simplified Representation — Two echelons of supply and maintenance with consideration of two levels of indenture only



The inventory environment in Figure 2 is highly dependent on the simple maintenance policy employed for the weapon system. Many weapon systems are deployed for longer periods of time and require scheduled overhauls and special repair programs. Often, in reality, the failure of a first indentured component is dependent on the failure of more than one second indentured item. The example was chosen to make the elementary concepts of the role played by DoD supply systems in the materiel readiness process assimilable.

From the DLA management perspective, some items are higher indentured but most are "piece parts" or lower indentured items. Although DLA items are "consumables," there were examples found where DLA-managed items were being repaired at Service depot maintenance facilities under local repair procedures. These items were being patched to extend beyond their intended life and "tired metal" problems were encountered.

DLA does impact the availability of weapon systems at the user level. It is not an uncommon occurrence when messages are received from the Services citing that many weapon systems are down at a certain installation due to lack of DLA parts. Our long-range goal is to minimize within the Agency's fiscal constraints, the nonavailability of weapon systems due to the unavailability of DLA-managed parts.

It can not be overstated that the materiel readiness of weapon systems is dependent on many logistical factors besides spares inventory such as depot maintenance capacity and backlog, maintenance support, and the number and skill level of operations and maintenance personnel. The relationship between spare parts inventory and materiel readiness must be viewed from this perspective. "Sparing-to-Availability" is but a part of the answer to the Department of Defense resource to materiel readiness problem.

On the other hand, the concern can no longer be only with repair parts supply availability or requirements levels for a wholesale system and its retail customers. The defense logistics environment must be viewed as a whole. The effects of both maintenance policies (where remove and replace actions occur, the level of repair and repairable time), and of supply response time (how long it takes to requisition and receive replacement components and piece parts), play a key role in the determination of DLA's contribution to materiel readiness.

B. Representative "Sparing-to-Availability" Models. This section will describe a few "Sparing-to-Availability" models currently used by the Services in their attempts to size spares requirements based on weapon system availability. Each model will be compared against a set of characteristics which are defined in Table 1. The complete technical documentation of the models can be found in the references. Reference 13 provides an overview of the problems of implementing for all the DoD components "sparing-to-availability" models. These models require detailed line-item data and consider a weapon system as a collection of compoents awaiting failure/replacement. The models use various mathematical techniques to estimate the expected number of backorders (EBOs) for various components and a subsequent weapon system availability for a given level of investment. The underlying assumptions are highlighted as these are very pertinent to the subject of a DLA interface with these models.

Table 1

"Sparing-to-Availability" Model
Characteristics

Characteristic	Description
A. Supply System Structure	The structure of DoD supply systems and weapon systems has resulted in multi-echelon (base, intermediate, depot-supply and maintenance), multi-indentured (assemblies, sub-assemblies, parts, etc.) representations.
B. Data Requirements - Detailed line-item - Application data - Resupply data	These models require the following item data such as unit cost and removal rate at different echelons; application data such as weapon system identifier; density and usage rate; the quantity per application; level of indenture and location of next higher assembly; resupply data such as number of echelons; the order and ship time between echelons; the average turnaround time for each echelon; the percentage of removals and repairs at each echelon; and the condemnation of each echelon and procurement lead time.
C. Resupply Policy - Ordering (1 for 1 or EOQ)	At the core of these "Sparing-to-Availability" models is the computation of expected backorders. There is an assumption of an (S-1,S) continuous review stockage policy or (1-for-1); that is, whenever a demand is received at a location and action is taken immediately to raise the spares level by 1.
- Demands	The demands received are assumed to be generated by a Poisson distribution and if the resupply time is independent of demand then the pipeline distribution will be Poisson, depending only on the average resupply time and not the distribution of resupply time (PALM's Theorem). This (METRIC) framework is at the core of most current models.
- Cannibalization	In the real world, serviceable components are removed from downed weapon systems to minimize the effects of materiel shortages. This process is even more popular today with modern modular components. This additional source of supply can result in an overestimation of stockage requirements and conversely, an underestimation of weapon system availability.

- Lateral Resupply	The practice of materiel transfer between Defense base activities (within the same echelon) is often not considered in the "Sparing-to-Availability" models. This can have a similar effect on weapon system availability/stockage requirements as cannibalization.
D. Repair Policy (1-1 or ERQ) - Independent Repair Times - Repair Queueing - Condemnations	The repair policy assumptions are critical to the model estimate of weapon system availability for a given investment cost. Trade-offs between the repair and procurement of reparables, batch collection of items to be shipped for repair, and batching on the repair line and condemnations are worthy assumptions. It is the weapon system repair cycles from which most of DLA's requirements are generated, and it is at that point where much of the DLA contribution to materiel readiness occurs.
E. Common Item Considerations	In reality, many weapon system parts are shared by other weapon systems and/or end items. Proper consideration of commonality is necessary if these models expect to better represent the real world. The models that consider commonality set stock levels to the greatest demand so that all systems benefit from the increased support. In DLA, the commonality problem and the EOQ reorder policy are the big obstacles impeding direct application of the "Sparing-to-Availability" models.
F. Requirements Application	A model may be used in the initial provisioning mode only, in the replenishment mode only, or both depending on the application.
G. Impediments to Direct Application by DLA	A summary of theoretical and/or practical impediments to the direct application of the model.

1. The Aircraft Availability Model (AAM). The AAM was initially developed in 1972 by the Logistics Management Institute for the United States Air Force. The AAM was first used by the Headquarters Air Force Logistics Command to allocate budgets for the procurement of replenishment spares and, in modified form, will form the basis for the Air Force requirements computation system for recoverable items. The AAM has been especially useful to the Headquarters Air Force (Air Staff) in the preparation and justification of spares planning, programming, and budgeting exhibits.

The AAM is an analytical model based on stochastic and economic concepts. It relates procurement and depot repair expenditures of recoverable (reparable) spares to aircraft availability rates. An aircraft is considered available if it is not awaiting completion of a resupply action involving a recoverable component. The lack of DLA-managed consumable spares is not considered in the computation of the aircraft availability rates.

The AAM uses a marginal analysis technique to produce an optimum shopping list for buys and repair strategies by component, that maximizes aircraft availability for each funding level. Table 2 presents a summary of significant characteristics for the AAM.

Reference 9 provides a demonstration of an approach relating Air Force stock fund to aircraft availability using the Aircraft Availability model.

Table 2

AAM Characteristics

Characteristic	Description
Supply System Structure	Multi-echelon (base-depot), multi-indentured aircraft (up to 5 levels)
Data Requirements	
- Detailed Line Item (Extract by Air Force D041)	Unit cost, procurement leadtime, depot turnaround time (TAT), base TAT, order and ship time (OST)
- Echelon Data	Condemnation rate
- System Level Data	Variance-to-mean ratio
- Demand Input	Rate
Resupply Policy	
- Reordering	(S-1,S) (base/depot)
- Pipeline Distribution	Stationary Poisson or Negative Binomial
- Cannibalization	No
- Lateral Resupply	No
Repair Policy	(S-1,S) (base/depot)
- Independent Repair Times	Yes (base/depot)
- Repair Begins Immediately	Yes (base/depot)
- Condemnations	Yes (base/depot)

Common Item Considerations	Yes, for recoverable spares across other aircraft types
Applications	Both replenishment and initial provisioning.
Impediments to DLA Application	METRIC component backorder computation is based on 1 for 1 reorder policy and Poisson and negative binomial pipeline distributions; both of which do not fit the great majority of DLA items

2. The Availability Centered Inventory Model (ACIM). The ACIM, developed by CACI, Incorporated, was approved for selected Navy applications by the Center of Naval Operations in 1981. The ACIM has been used, for the most part, for consumer-level requirements calculations in initial provisioning, although there have been limited applications in the multi-echelon mode. The objective function of ACIM is to maximize A_o (weapon system up-time/total time) for a given spares budget level. A critical implementation problem in the application of ACIM is the definition of weapon system. The model has been applied, for the most part, to electronic subsystems of new weapon systems. Another concern is the validity of input data and the tremendous amount of data "scrubbing" required prior to execution of the model.

The ACIM uses a marginal analysis technique that iteratively selects the item that gives the greatest increase in operational availability for the least cost. Thus, the model builds inventory levels for all items until the A_o goal or budget constraint is reached.

The ACIM has been used to set initial stockage requirements for selected weapon sub-systems at the consumer level (SURTASS, LAMPS MK III [SH-60B], AN/SPG-55) and to set initial stockage requirements for the Phalanx (CIWS) across all supply echelons. Reference 4 provides a users manual for ACIM. Table 3 summarizes the significant characteristics of the ACIM.

Table 3

ACIM Characteristics

Characteristic	Description
Supply System Structure	Multi-echelon with multi-indentured weapon systems.
Data Requirements	
- Detailed Line Item Location	Unit cost, procurement lead time, essentialty, next higher assembly, density, failure rate, order and ship time, (depot, intermediate and organizational turnaround time), removal/replacement rates, and condemnation rate

- End Item	Mean Time Between Failure (MTBF), Mean Time To Repair (MTTR)
- System	Lagrange Parameter
Resupply Policy	
- Reordering	Continuous (S-1,S) (all echelons)
- Pipeline Distribution	Stationary; Poisson or Negative Binomial
- Cannibalization	No
- Lateral Resupply	No
Repair Policy	(S-1,S) (all echelons)
- Independent Repair Times	Yes (all echelons)
- Repair Begins Immediately	Yes (depot/intermediate levels) No (organizational level)
- Condemnations	Yes (depot/intermediate levels) No (organizational level)
Common Item Considerations	Manual intervention only
Application	Provisioning only for selected weapon sub-systems; more extensive use planned in the near future
Impediments to DLA Application	Expected backorder computations based on 1 for 1 reorder policy and Palm's theorem; both of which do not fit the stockage profile for most DLA items

3. The Selected Stockage for Availability Multi-Echelon Method (SESAME). SESAME, developed by the Army Inventory Research Office [Reference 1], is used by the Army for determining initial provisioning levels and war reserve requirements. SESAME allocates spares to units at different echelons based upon a fixed budget. By using multiple iterations of SESAME, the optimum stockage policy to use for a given budget and availability goal can be determined. Outputs include the allocation of parts by supply echelon and the total cost of spares at each echelon for a target level of availability or cost. Table 4 summarizes the important characteristics of SESAME.

Table 4

SESAME Characteristics

Characteristic	Description
Supply System Structure	Multi-echelon with multi-indentured weapon systems.
Data Requirements	
- Detailed Line Item	Unit cost, essentiality, density, next higher assembly, failure rate, (depot, intermediate and organizational turnaround time), removal/replacement rate and condemnation rates
- End Item	Mean Time Between Failure (MTBF), Mean Time to Repair (MTTR), Order and Ship Time, nonreturn rate (carcasses)
- System	Procurement lead time wholesale fill rate
Resupply Policy	
- Reordering	Continuous (S-1,S) (all echelons)
- Pipeline Distribution	Poisson
- Cannibalization	No
- Lateral Resupply	No
Repair Policy	(S-1,S) (all echelons)
- Independent Repair Times	Yes (all echelons)
- Repair Begins Immediately	Yes (all echelons)
- Condemnations	Yes (all echelons)
Common Item Considerations	None

Application	Used for provisioning spares for a number of weapon systems
Impediments to DLA Application	Order policy and pipeline distributions don't fit those of the majority of DLA items

C. Summary. Current service "sparing-to-availability" models cannot be directly applied to the DLA supply system. However, there are a number of input variables in the service readiness models such as wholesale fill rate, order and ship time from the wholesale echelon to lower echelons, and maintenance turnaround time at all echelons, which are affected by DLA supply support. The problem of quantifying the effect of DLA supply support on these inputs is complicated by the fact that the level of indenture for most DLA weapon system items is unknown. Another major difficulty is the problem of item commonality.

IV. Potential Interface between MARS and Service Readiness Models.

A. Assessment. The present DLA Materiel Readiness Support System (MARS) cannot be directly linked with service readiness models. The outputs from MARS cannot be used to compare the effects of varying levels of DLA supply support to weapon system availability. This section of the report describes an approach that DLA might follow to develop an interface with the Service "Sparing-to-Availability" Models.

There are two suggested ways to develop a link between DLA stock fund weapon system investment and Weapon System Availability. One involves the use of a detailed line item based multi-echelon model based on weapon system application. The other involves the use of an aggregate model which estimates the logistics delay time from DLA to its customers. Since configuration data is not available for most DLA managed weapon system items and, due to the large degree of DLA item commonality between weapon systems, a detailed line item based multi-echelon model approach is not presently feasible. However, the aggregate analytic model approach appears feasible. The thrust of this approach is to provide DLA with the capability to compute the mean logistics delay time for specific weapon system classes of DLA items for a range of stock fund budget levels. These mean logistics delay times would then be provided to OSD and Service weapon system availability planners to determine the best mix of Service managed spares and DLA budget level to achieve target weapon system availability goals.

B. Approach.

1. Task 1 - MARS Enforcement. Task 1 involves the enhancement of the MARS model. This enhancement would involve modeling depot response and transportation times for DLA managed weapon system items. The depot response time is the time from the date the ICP offers the materiel for shipment to the date the materiel is shipped from depot to customer. The transportation time is the time from depot shipment to customer receipt. The logistics delay time is the sum of ICP response time, depot response time, and transportation time. The mean logistics delay time is the average logistics delay time over all DLA managed items for a specific weapon system.

2. Task 2 - Essentiality Considerations. Task 2 involves consideration of whether or not shortage of a specific DLA item could make a weapon system nonoperational. In other words, the identification of DLA managed items both essential to the operation and directly indentured to the weapon system. This can be accomplished through the DLA Weapon System Support Program and an investigation of Not Mission Capable Supply (NMCM) incidents due to DLA managed items.

3. Task 3 - Trial Evaluation of Methodology. Through the use of the enhanced MARS model, estimates of logistics delay time for differing levels of DLA stock fund investment would be computed for a specific weapon system. Much of the DLA weapon system requirement is generated by the movement of reparable components through various maintenance echelons. The effects of shortages of DLA parts at the different echelons of supply affect weapon system availability in a different ways. Therefore, the effects of logistics delay time on weapon system availability may vary depending on which echelon the maintenance is performed.

V. Conclusions and Recommendations.

A. Conclusions.

1. Quantification of DLA's contribution to Materiel Readiness is difficult. Lack of asset visibility and commonality complicate the use of present "sparing-to-availability" models. Flexibility of stock fund and inventory managers make real world predictions difficult.

2. Through enhancements to the MARS systems and additional model development, DLA can develop the capability to estimate mean logistics delay time for weapon system items based on different levels of investment.

B. Recommendations.

It is recommended that DLA take the following actions:

1. Develop enhancements to the MARS system to account for logistics delay time in lieu of ICP response time.

2. Undertake a study of Not Mission Capable - DLA Supply incidents, and identify directly indentured, essential weapon system items.

3. Test the results of recommendations (1) and (2) in a real application of Army, Navy, and Air Force "Sparing-to-Availability" models.

Appendix A

Field Research Sites

Office of the Assistant Secretary of Defense (Manpower, Installations and Logistics)

Office of the Deputy Assistant Secretary of Defense for Logistics and Materiel Management (Logistics Planning and Analysis, Weapon Systems) - Washington, DC

Office of the Deputy Assistant Secretary of Defense for Program Integration (Force Readiness and Sustainability Staff) - Washington, DC

Army

Office of the Deputy Chief of Staff for Logistics - Washington, DC

Headquarters, U.S. Army Materiel Development and Readiness Command - Alexandria, Virginia

U.S. Army Inventory Research Office - Philadelphia, Pennsylvania

Navy

Office of the Chief of Naval Operations - Washington, DC

Headquarters, Naval Supply Systems Command - Washington, DC

Headquarters, Naval Air Systems Command - Washington, DC

Fleet Material Support Office - Mechanicsburg, Pennsylvania

Ship Parts Control Center - Mechanicsburg, Pennsylvania

Aviation Supply Office - Philadelphia, Pennsylvania

Naval Air Development Center - Johnsville, Pennsylvania

Air Force

Office of the Deputy Chief of Staff for Logistics and Engineering - Washington, DC

Headquarters, Air Force Logistics Command - Dayton, Ohio

Marine Corps

Headquarters, U.S. Marine Corps - Rosslyn, Virginia

Marine Corps Logistics Base - Albany, Georgia

Other Defense-Related Organizations

Center for Naval Analyses - Alexandria, Virginia

Logistics Management Institute - Washington, DC

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Appendix B

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